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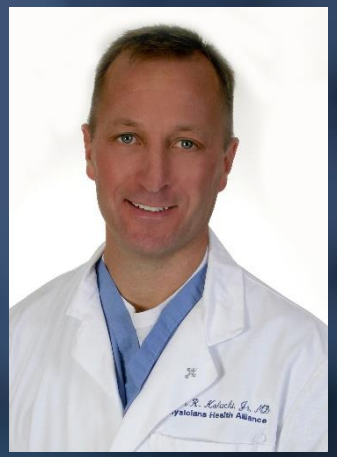

Addressing the Tragedy of Maternal Mortality & Morbidity in America

A presentation for HealthTrust Members by

Frank R. Kolucki, Jr., M.D., FACOG

Chairman of the Department of Obstetrics/Gynecology, Moses Taylor Hospital

Disclosures

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Addressing the Tragedy of Maternal Mortality & Morbidity in America:

Part 2, Code Crimson: Massive Transfusion Protocol in Obstetrics

Learning Objectives

- Define risk factors which contribute to catastrophic maternal hemorrhage
- Recall why massive transfusion protocols are physiologic and effective
- Explain the benefits of utilizing an evidence-based care team approach to aid patients in extremis

Code Crimson: Massive Transfusion Protocol in Obstetrics

A Quality and Safety Initiative

Maternal Mortality

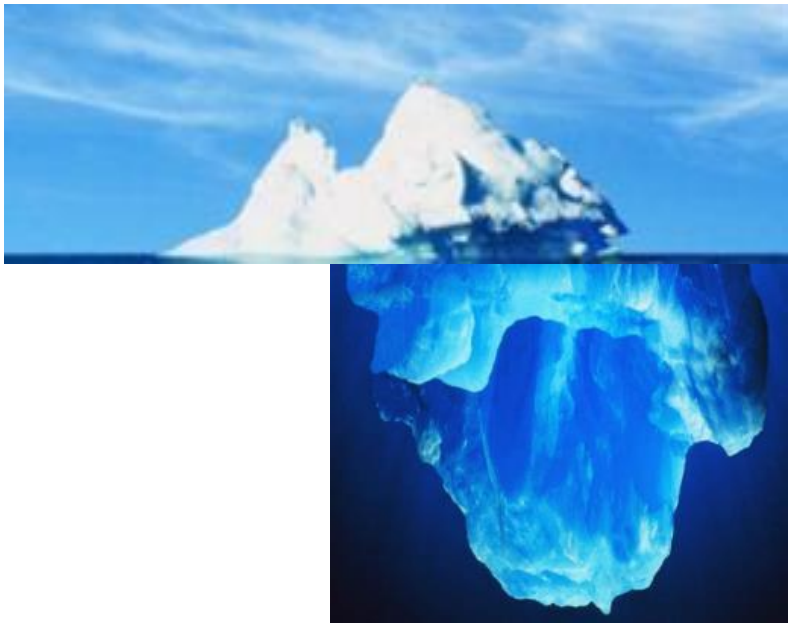
An American Failure

- America is the most dangerous country in the developed world to give birth
- U.S. ranks 60th in the world regarding maternal death rate*
- Increased from 14 to 26.4 / 100,000 Births from 1990–2015
- Occurred during a time of unprecedented medical advancement
- Maternal death classified as “Never Event” by CHS OB Collaborative
- Greatest tragedy in modern medicine

Source: *ACOG Patient Safety and Quality Improvement.* Berg Cl et all Obstet Gynecol 2012
WHO, UNICEF, UNFPA, The World Bank, and UNDP. Trends in Maternal Mortality 1990-2013 :2014

Maternal Morbidity is Extreme

- Shock
- Acute Kidney Injury
- Pulmonary Embolism
- Acute Respiratory Distress Syndrome (ARDS)
- Myocardial Infarction
- Sepsis
- Increased by 45% from 2006 - 2015
- Affects 80,000 mothers per year



Sources: Callaghan, Wm et al. Obstet, Gynecol, 2012.
K Fingar et al Trands and Disparities in Delivery Hospitalizations Involving Severe Maternal Morbidity, 2006-2015

Maternal Fetal Medicine

- Antenatal Steroids
- Antibiotics for PPROM
- Magnesium for Neuroprotection
- 17 Hydroxyprogesterone for Preterm Birth Prevention
- Fetal Therapy for TTS, NAIT and NTD
- Head/body cooling for Hypoxic Ischemic Encephalopathy

Where is the “M” in Maternal-Fetal Medicine?

Clear Need for Action

Current Commentary

Where Is the “M” in Maternal–Fetal Medicine?

Mary E. D'Alton, MD

In contrast to the generally encouraging trend regarding global maternal mortality, there has been an apparent increase in the maternal mortality ratio in the United States. Although maternal death remains a relatively rare adverse event in this country, programs to reduce maternal mortality also will result in a reduction in maternal morbidity, which is a far more prevalent problem. Progress in the field of maternal–fetal medicine over the past several decades has been largely attributable to improvements in fetal and neonatal medicine. We need to develop an organized, national approach focused on reducing maternal mortality and morbidity. The goal will be to outline a specific plan for clinical, educational, and research initiatives to put the "M" back in maternal–fetal medicine.

(Obstet Gynecol 2010;116:1401–4)

Twenty-five years ago, in a seminal article published in the *Lancet*, Allen Rosenfield and Deborah Maine alerted the public to the tremendous problem of global maternal mortality.[1] Recognizing that maternal–child health care programs in developing countries were doing little to reduce maternal mortality and improve maternal health, this commentary was a call to action for health professionals, policy makers, and politicians to focus on this critical issue. Soon thereafter, the international movement to reduce maternal mortality was launched at the global Safe Motherhood Conference in Nairobi, Kenya. Finally, the international community acknowledged the importance of maternal health in the broader context of women's rights and equality and committed resources to decreasing maternal mortality. More recently, reduction in maternal mortality became one of the eight Millennium Development Goals of the United Nations.[2]

There has been good news this year in the progress toward the Millennium Development Goals of the United Nations, which targets a reduction in the maternal mortality ratio by 75% from 1990 to 2015. In a comprehensive analysis funded by the Bill and Melinda Gates Foundation, estimates of global maternal deaths have declined from 526,300 in 1980 to 342,900 in 2008.[3] Maternal mortality is difficult to measure, particularly in developing countries; thus, there are wide uncertainty intervals around these numbers. Nevertheless, these new estimates provide hope that interventions to reduce fertility rates, increase income and education, and expand access to skilled birthing attendants, among other efforts, may be producing the desired results. Because only a minority of countries is currently on track to meet the Millennium Development Goals of the United Nations, it is imperative that the global health community remains fully committed to this goal. At this year's Women Deliver conference, Melinda Gates pledged $1.5 billion toward maternal, newborn, and child health in developing countries over the next 5 years, the second largest donation in the foundation's history. This money not only will enormously help countries with the highest rates of maternal mortality but also it may prompt governments and organizations worldwide to invest more toward maternal health.

In contrast to the generally encouraging trend regarding global maternal mortality, there has been an apparent increase in the maternal mortality ratio in several high-income countries, such as the United States, Canada, Denmark, and Norway.[3] This is not the first evidence that maternal mortality is increasing in the United States. The National Center for Health Statistics has reported that the maternal mortality ratio increased by 62% between 1990 and 2006, from 8.2 to 13.3 per 100,000.[4] These increases have been largely attributed to methodological changes in the

From the Department of Obstetrics and Gynecology, Columbia University Medical Center, and New York Presbyterian Hospital, New York, New York.

Corresponding author: Mary E. D'Alton, MD, Department of Obstetrics and Gynecology, Columbia University Medical Center, 622 West 168th Street, PH 16-20, New York, NY 10032; email: med37@columbia.edu.

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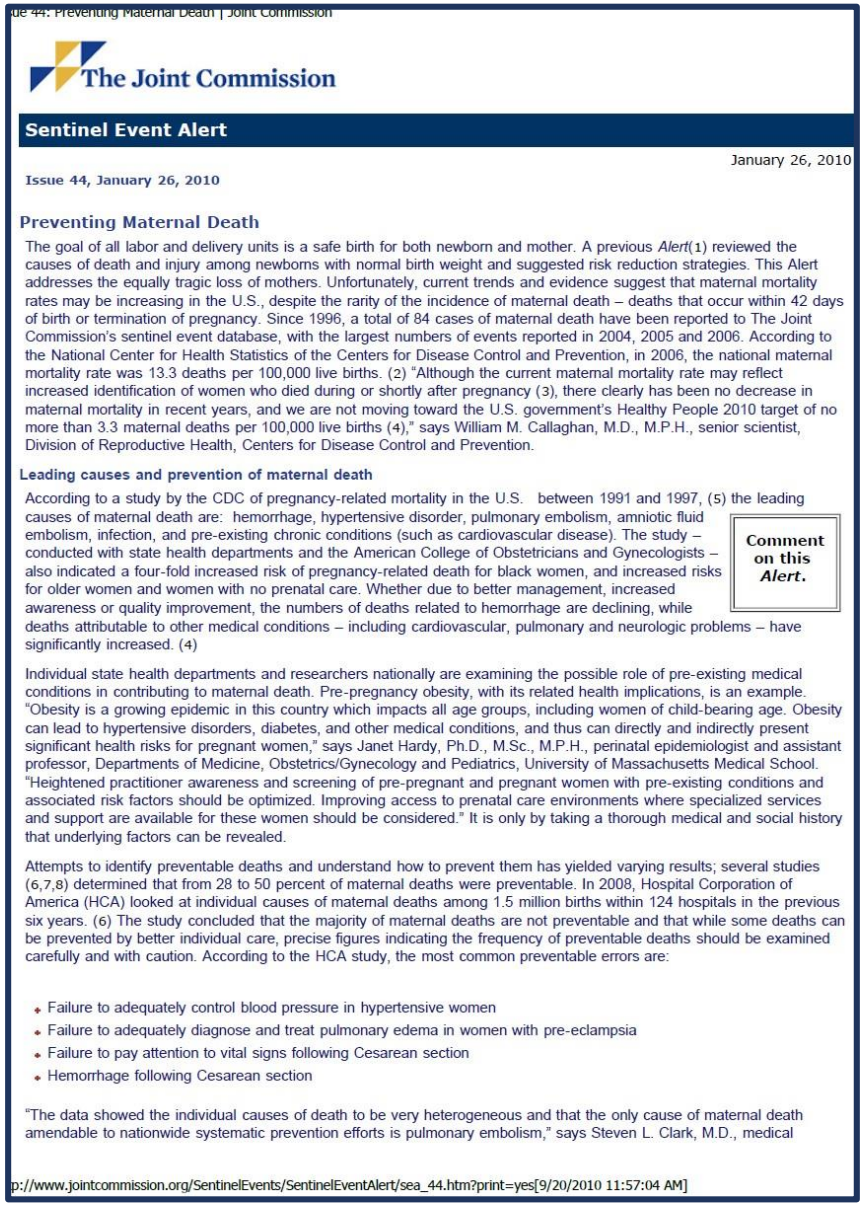
National Focus



ue 44: Preventing Maternal Death | Joint Commission

The Joint Commission

Sentinel Event Alert

January 26, 2010

Issue 44, January 26, 2010

Preventing Maternal Death

The goal of all labor and delivery units is a safe birth for both newborn and mother. A previous *Alert*(1) reviewed the causes of death and injury among newborns with normal birth weight and suggested risk reduction strategies. This Alert addresses the equally tragic loss of mothers. Unfortunately, current trends and evidence suggest that maternal mortality rates may be increasing in the U.S., despite the rarity of the incidence of maternal death – deaths that occur within 42 days of birth or termination of pregnancy. Since 1996, a total of 84 cases of maternal death have been reported to The Joint Commission's sentinel event database, with the largest numbers of events reported in 2004, 2005 and 2006. According to the National Center for Health Statistics of the Centers for Disease Control and Prevention, in 2006, the national maternal mortality rate was 13.3 deaths per 100,000 live births. (2) "Although the current maternal mortality rate may reflect increased identification of women who died during or shortly after pregnancy (3), there clearly has been no decrease in maternal mortality in recent years, and we are not moving toward the U.S. government's Healthy People 2010 target of no more than 3.3 maternal deaths per 100,000 live births (4)," says William M. Callaghan, M.D., M.P.H., senior scientist, Division of Reproductive Health, Centers for Disease Control and Prevention.

Leading causes and prevention of maternal death

According to a study by the CDC of pregnancy-related mortality in the U.S. between 1991 and 1997, (5) the leading causes of maternal death are: hemorrhage, hypertensive disorder, pulmonary embolism, amniotic fluid embolism, infection, and pre-existing chronic conditions (such as cardiovascular disease). The study – conducted with state health departments and the American College of Obstetricians and Gynecologists – also indicated a four-fold increased risk of pregnancy-related death for black women, and increased risks for older women and women with no prenatal care. Whether due to better management, increased awareness or quality improvement, the numbers of deaths related to hemorrhage are declining, while deaths attributable to other medical conditions – including cardiovascular, pulmonary and neurologic problems – have significantly increased. (4)

Comment on this *Alert*.

Individual state health departments and researchers nationally are examining the possible role of pre-existing medical conditions in contributing to maternal death. Pre-pregnancy obesity, with its related health implications, is an example. "Obesity is a growing epidemic in this country which impacts all age groups, including women of child-bearing age. Obesity can lead to hypertensive disorders, diabetes, and other medical conditions, and thus can directly and indirectly present significant health risks for pregnant women," says Janet Hardy, Ph.D., M.Sc., M.P.H., perinatal epidemiologist and assistant professor, Departments of Medicine, Obstetrics/Gynecology and Pediatrics, University of Massachusetts Medical School. "Heightened practitioner awareness and screening of pre-pregnant and pregnant women with pre-existing conditions and associated risk factors should be optimized. Improving access to prenatal care environments where specialized services and support are available for these women should be considered." It is only by taking a thorough medical and social history that underlying factors can be revealed.

Attempts to identify preventable deaths and understand how to prevent them has yielded varying results; several studies (6,7,8) determined that from 28 to 50 percent of maternal deaths were preventable. In 2008, Hospital Corporation of America (HCA) looked at individual causes of maternal deaths among 1.5 million births within 124 hospitals in the previous six years. (6) The study concluded that the majority of maternal deaths are not preventable and that while some deaths can be prevented by better individual care, precise figures indicating the frequency of preventable deaths should be examined carefully and with caution. According to the HCA study, the most common preventable errors are:

- Failure to adequately control blood pressure in hypertensive women
- Failure to adequately diagnose and treat pulmonary edema in women with pre-eclampsia
- Failure to pay attention to vital signs following Cesarean section
- Hemorrhage following Cesarean section

"The data showed the individual causes of death to be very heterogeneous and that the only cause of maternal death amendable to nationwide systematic prevention efforts is pulmonary embolism," says Steven L. Clark, M.D., medical

p://www.jointcommission.org/SentinelEvents/SentinelEventAlert/sea_44.htm?print=yes[9/20/2010 11:57:04 AM]

An American Tragedy

50% of Maternal Deaths are Preventable

90% of Deaths from Hemorrhage are Preventable

Source: D'Alton, et al. National Partnership for Maternal Safety 2014

Maternal Mortality

Three Significant Etiologies/Three Opportunities/Three High Value Targets

- Hemorrhage
- Hypertension/Preeclampsia/Eclampsia
- Thromboembolism

Source: National Partnership Maternal Safety. AC8 OG 2014

Healthcare is a Team Sport

HealthTrust Team Members

- Nursing
- Pharmacy
- Laboratory Medicine
- Physicians
- Administrators

Healthcare is a Team Sport

Maternal mortality and morbidity crisis cannot be fixed by obstetricians alone.

Need your help in your sphere of influence.

Focus on Massive Transfusion Protocol: Code Crimson

- Evidenced-based protocol in the treatment of a life-threatening Peripartum Hemorrhage.

There's No Bleeding Like Obstetrical Bleeding

It's Audible

Why is Obstetrical Bleeding So Bad?

- Uterine Perfusion at Term > 700cc / minute
- Extreme hemorrhage → exsanguination → pulselessness → hypoperfusion of brain/myocardium → cerebral anoxia and fatal arrhythmia in minutes
- Significant predisposition for coagulopathy
- Tissue Factor → thrombin production → consumptive coagulopathy “DIC”

Source: *Tisherman, SA.et all J Trauma Acute Care Surgery 2017*

Obstetrical Predisposition to Coagulopathy/DIC

- Consumption of clotting factors during severe hemorrhage
- Abruption
- HELLP Syndrome/Eclampsia/Severe Preeclampsia
- Amniotic Fluid Embolism/Anaphylactoid Syndrome of Pregnancy
- Acute fatty liver
- Iatrogenic i.e., Dilutional Coagulopathy
- Sepsis

Predisposition to Coagulopathy

Tissue Factor(thromboplastin) → Thrombin production → Coagulopathy/DIC

Tissue Factor Exposure Potentiated By

- Abruption
- Endothelial damage from shock
- HELLP Syndrome Preeclampsia / Eclampsia
- Fetal demise (rare)

Blood Component Therapy

What We Have to Work With

Blood replacement products: Recommended uses and effects in adults

Product (mL)	Contents	Uses and effects
Whole blood (1 unit = 500 mL)	All components	Rarely required. Consider when massive bleeding requires transfusion of >5 to 7 units of packed red cells.
Red cells + additive solution (1 unit = 350 mL)	Red cells	One unit increases hematocrit by 3 percentage points and hemoglobin by 1 g/dL.
Frozen plasma (1 unit = 200 to 300 mL)	All clotting factors, but no platelets	Best used to correct deficiencies of multiple coagulation factors (eg, DIC, liver disease, warfarin overdosage). One unit FFP increases fibrinogen by 7 to 10 mg/dL. Usual dose is 10 to 15 mL/kg.
Cryoprecipitate (1 unit = 10 to 20 mL)	Fibrinogen, factors VIII, XIII, VWF	Typical dose consists of two bags of prepooled cryoprecipitate (total of 10 units), which will raise plasma fibrinogen by 70 mg/dL in a 70 kg recipient.
Whole blood-derived and apheresis-derived platelets (1 unit = 200 to 300 mL)	Platelets	Six units of whole blood-derived or one unit of apheresis-derived platelets will raise the platelet count by approximately 30,000/microL in an average sized adult.

Frozen blood products (plasma, cryoprecipitate) take 15 to 30 minutes to thaw. It may take the same amount of time to perform an uncomplicated crossmatch.

DIC: disseminated intravascular coagulation; FFP: fresh frozen plasma; VWF: von Willebrand Factor; kg: kilograms.

UpToDate®

Blood Component Therapy in Obstetrical Hemorrhage

The Old Way:

- 4 units of PRBC +/- 1 unit FFP; Hope for the Best
- → Leads to the dilutional coagulopathy and severe life threatening hemorrhage

Medicine Advances Exponentially in Wartime

- Massive Transfusion Protocols have developed as a direct result of the Afghanistan / Iraq war experience
- Validated through the experience of major trauma centers

The New Way / Damage Control Resuscitation

Higher ratios of FFP and Platelets to PRBC

Higher ratios of FFP and Platelets to PRBC

PRBC : FFP : Platelets + cryoprecipitate

1 1 1 10-20 units

(for obstetrical patients)

Apheresis concentrate or six units of whole blood derived platelets

- Blood products are cornerstone of resuscitation not crystalloids or colloids (use lactated ringers when necessary)
- Once activated, blood bank will provide predefined ratio of blood component therapy without waiting for lab results

Sources: Borgman MA, Spinella PC, Perkins JG, et al. J Trauma 2007;63:805
Holcomb JB,Wade CE, Michalek JE, et al. Ann Surg 2008;248:447
Cotton BA, Au BK, Nunez TC, et al. J Trauma 2009; 66:41
Shaz BH, Dente CJ, Nicholas J, et al. Transfusion 2010;50:493
Inaba K, Lustenberger T, Rhee P, et al. J Am Coll Surg 2010;211:573
De Biasi AR, Stansbury LG, Dutton RP, et al. Transfusion 2011;51:1925
Perkins JG, Cap AP, Spinella PC et al. J Trauma 2009; 66:S77
Johansson PI, Stensella J, Rosenburg I, et al. Transfusion2007; 47:593

Why is This Better?

- More physiologic, mimics whole blood
- Staves off coagulopathy, acquired, induced via non-judicious use of crystalloids or colloids as volume expanders
- Infusion of cold fluids exacerbates heat loss, dilution of clotting factors and decreases O_2 carrying capacity → Oxygen Debt/Acidosis
- Combats part of death triad of
  - Consumptive Coagulopathy / DIC
  - Hypothermia
  - Acidemia (potentiates D.I.C).

Why Cryoprecipitate Is **Important** in **Obstetric Hemorrhage**

- Can’t clot without fibrinogen
- Fibrinogen is often exceedingly low in Post Partum Hemorrhage

Does it Work?

Evidence

- Retrospective study of 246 combat trauma patients
  - Physiologic Massive Transfusion Protocol (MTP) recipients had increased survival rate 88% vs. 66%
- Implementation of MTP dramatically decreased mortality at a major trauma center
- Proven Survival Benefit
- Preventing Maternal Death: 10 Clinical Diamonds
  - "If your L/D does not have a recently updated MTP based on trauma protocols, get one today!"

Sources: Borgman MA, Spinella PC, Perkins JG et all J Trauma 2007
Trauma 2008 65:527-534 Gunter OL Jr
Cannon J W,Khan MA, Raja et al. Damage control resuscitation in patients with severe trauma
J Trama Acute Care Surgery 2017 ; 82:605-17.
Steven L. Clark MD, Gary Hankins M.D., Obstet Gynecol 2012; 119:360-4

When to Start Massive Transfusion Protocol

- At the outset of severe life threatening hemorrhage
- DO NOT WAIT FOR LABS
- Delay leads to death triad of
  - Consumptive Coagulopathy “DIC”
  - Hypothermia
  - Acidemia

Denial → Delay → Death

When to Start Massive Transfusion Protocol, *continued*

- Look at the patient
  - Signs of hemodynamic instability
  - Anxiety – tachypnea – confusion – lightheadedness
  - Weak pulse
  - Skin color pink vs. pale – blue or mottled
  - Cold extremities or diaphoresis
  - Shortness of breath or palpitations
  - Vitals SBP < 100, pulse >110, O2 sat < 95% RA
  - Urine output < 30 cc/hr
  - Lee & White test/wall clot/rough test of coagulopathy
    - If no clot in redtop within 6 minutes or if clot forms and lyses within 30 minutes fibrinogen usually < 150 mg / dl
  - Oozing from surgical site
  - Consistency of blood is watery red (no clot) vs. thick port wine color

Don’t put your head in the sand!

Re Labs—Evaluation During Massive Hemorrhage

- CBC
- ↑ PT/PTT
- Fibrinogen (minimum of 100mg /dl to form clot)
- < 200 = 100% positive predictive value for severe life-threatening PPH

Don’t Wait!

Obstetrical Coagulopathy is Fulminant Coagulopathy

Source: Charbit et al. J Thromb Haemost (2007)

Point of Care Testing (POCT)

- POCT of Hgb, HCT and coagulation allows rapid availability of test results to aid clinical decision-making at the bedside/OR table
- Thromboelastography or rotational thromboelastography can be used to identify coagulation abnormalities

Source: Waters, M.D., Perioperative Blood Management 2009

Quantitate Blood Loss Accurately

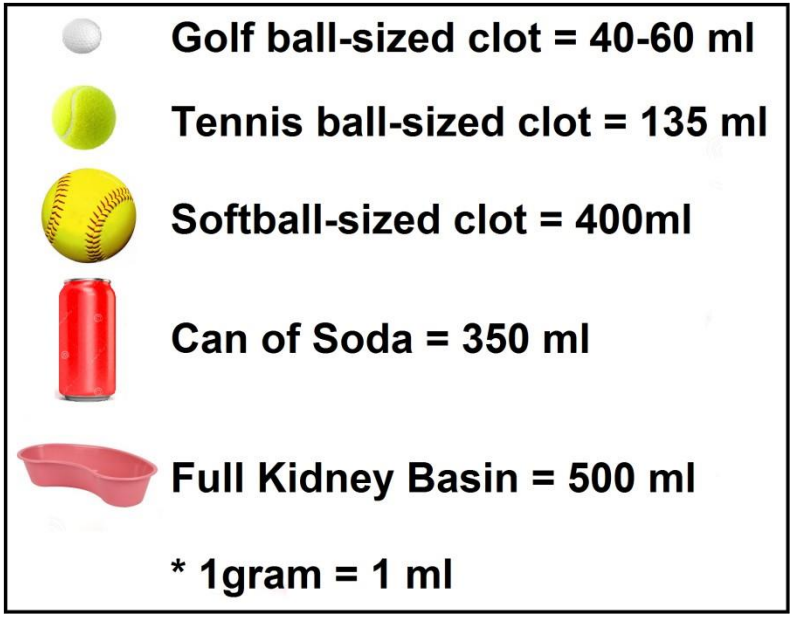
- Measurement should be a formal process in each obstetrical unit
- Use graduated fluid collection system
- Weigh pads
- Accurately assess clot size

Don’t Estimate / Quantitate!

Important Values to Know

EBL NSVD	**≤ 500 ml**
EBL C/S	**≤ 1000 ml**
Amniotic Fluid	**- 700 ml**
Oligohydramnios	**- 300 ml**
Polyhydramnios	**- 1400 ml**

Common Item Size Estimates



Estimation Chart

Hematologic Goals in Massive Obstetric Hemorrhage

- Hemoglobin > or = 10 g/dl pre-delivery
  - Lower hemoglobin acceptable after delivery when stable
  - PT < 1.5 X Control
  - PTT < 1.5 X Control
  - Fibrinogen > 200 mg / dl
  - Platelets > or = 50,000s /microL

Code Crimson: Massive Transfusion Protocol (MTP)

Goal: To Martial Support of Entire Hospital to Save Patient

- Well-coordinated early and aggressive multidisciplinary team effort including obstetricians, nursing, anesthesia, pharmacy, critical care medicine, OR staff, laboratory medicine, blood bank, imaging, ICU, hematology, administration, etc.
- Chaos → organized chaos → proficiency → EXPERT, HIGHLY RELIABLE, COLLABORATIVE CARE

TXA

Tranexamic Acid

- Obstetrical hemorrhage game changer!
- The WOMAN Trial (World Maternal Antifibrinolytic Trial)
  - Landmark, multinational, randomized, double-blind, placebo-controlled trial
- Decrease in deaths due to PPH by 20–30%!
  - Including both vaginal and cesarean deliveries
  - No increase in adverse events / clotting

Source: Lancet April 26, 2017

TXA, *continued*

Tranexamic Acid

- Give early! Minutes Matter
- Give often (best within three hours of hemorrhage)
- Dose one gram
  - 10ml of a 100 mg/ml solution over 10-20 min
  - Repeat in 30 minutes if still bleeding
- Should be emergency release medication in all obstetrical units

Source: Lancet April 26, 2017

TXA, *continued*

CAVEATS

- Do not run in IV blood line
- Do not mix with solutions containing Penicillin
- Possible GBS+ patients
- Contradicted in subarachnoid hemorrhage or active intravascular clotting (DIC)
- Reduce dose with Renal Insufficiency
  - Not likely in child bearing population
  - Be mindful of possible acute kidney injury

MTH Code Crimson v19

Code Crimson – Level 1

For patients with potential / actual hemorrhage

FBS Staff- Notify Switchboard of Code Crimson (x5555) for overhead page
Switchboard will alert Laboratory, Anesthesia, Ultrasound, Interventional Radiology, Nursing Supervisor, and Pharmacy to await further instructions
Draw the following STAT Labs and tube specimens to Laboratory for:
Code Crimson- CBC; PT / PTT; Fibrinogen; CMBP;
Type and Screen; and Type and Cross **Three (3) Units Packed Red Blood Cells, Three (3)Units Fresh Frozen Plasma, and One (1) Unit Aphoresed Platelets**
Notify Lab (x6300) of inbound STAT Blood Work
Repeat Labwork every 60 minutes or after every completed MTP.
Ensure IV access & Patency
Confirm treatment with Tranexamic Acid 1 gm IV repeat in 30 minutes if bleeding continues
Obtain Uterine Tamponade Balloon
Prepare OR Hysterectomy pan
Notify CRNA to prepare Rapid Infuser/ Blood Warmer

Code Crimson – Level 2

For patients with a **life threatening** potential/actual hemorrhage

Notify Switchboard of Code Crimson (X5555) for overhead page and alerts
Confirm treatment with Tranexamic Acid 1 gm IV repeat in 30 minutes if bleeding continues
FBS Staff – Draw the following **STAT** Labs and tube specimens to Laboratory for:
CBC; PT / PTT; Fibrinogen; Type and Screen; CMBP, and Type and Cross
Six (6) Units Packed Red Blood Cells, Six (6) Units Fresh Frozen Plasma, One (1) Unit Aphoresed Platelets, and Ten (10) Unit Cryoprecipitate (only 1 unit plts in hospital; additional units will be procured by lab)
Notify Lab (x6300) and Blood Bank (x6361) of inbound STAT Blood Work
T/L will designate one person to be in contact with lab for blood products and to obtain when ready (blood runner).
Repeat Labwork work every 60 minutes or after every completed MTP.
- **Ensure two (2) large bore (#18) IV access**
- **Prepare OR Hyster pan/Prepare Uterine Tamponade Balloon**
  Ready Second MTP2 PACKAGE
  - **6 Units RBCs**
  - **6 Units FFP**
  - **1 Unit Aphoresed Platelets**
  - **10 Units Cryoprecipitate**
  - **Administer 10 mg Vitamin K IV for 1 dose**
  - **Calcium Gluconate 2 gm (4.65meq/ 1gm) IV**
  (lab will procure any additional blood products as needed)

Laboratory may contact the **FBS-Charge Nurse/ TL @ x6908**

Nursing Supervisor (x6867/6768)
Anesthesiologist
Anesthesia CRNA (x6925)
* **Prepare Rapid Infuser/ Blood Warmer**
If necessary, Anesthesia will notify Cell Saver perfusionist - James Yi (H) 570-587-2510 (C) 570-815-6577

If AB plasma for AB patient is not available A plasma may be used

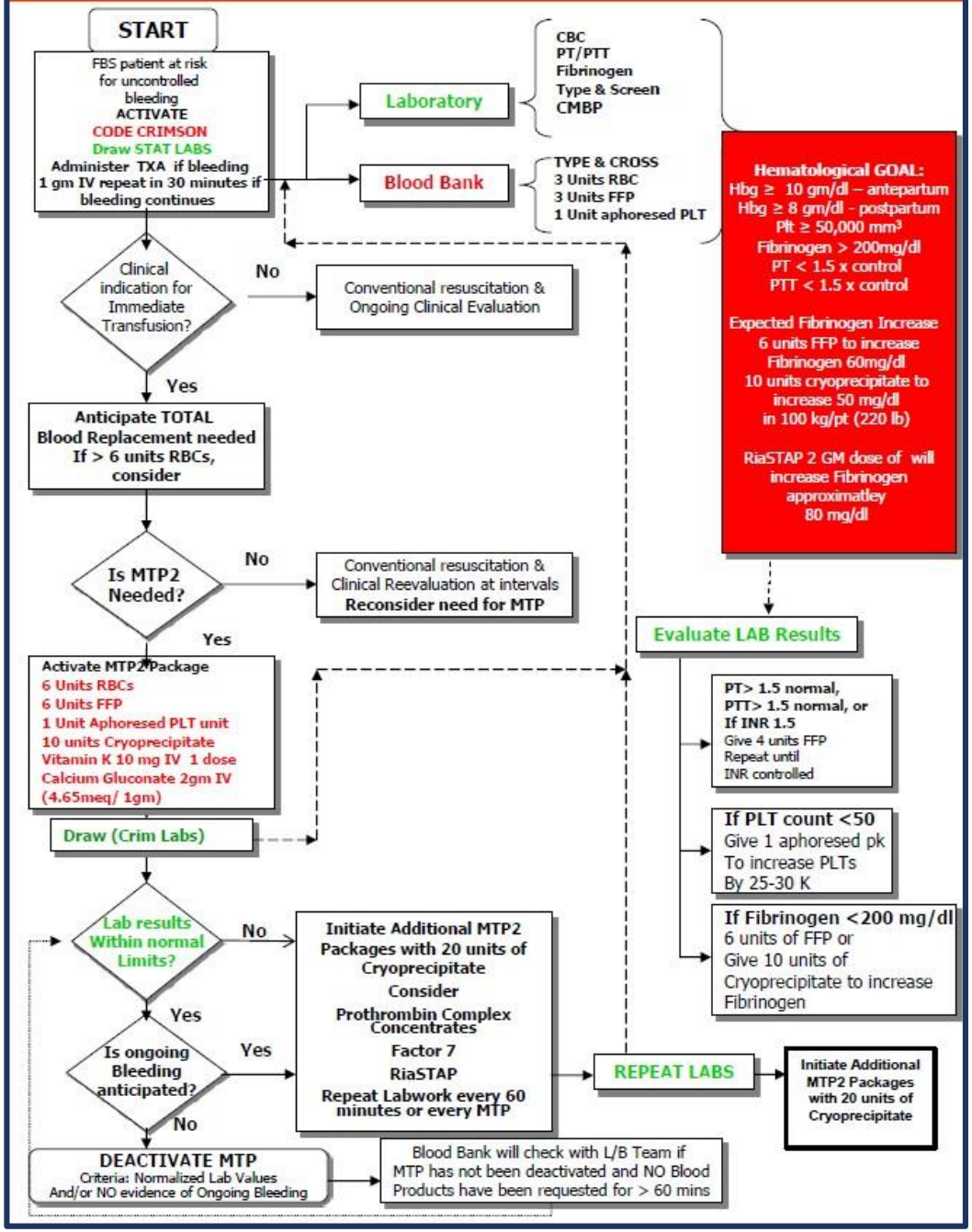
Operating Room (x6400)
Interventional Radiology (x7306) (OB/GYN Physician or designee must speak directly with Radiologist)
If necessary, **Notify Rapid Response Team (RRT)**
Dial #5555, provide Switchboard Operator with Room Number / location for RRT response
Notify ICU of possible transfer (x5480)
Notify second in-house OB physician of situation
IF ANTICIPATING ONGOING BLEEDING:
- **Repeat STAT LABS- CBC; PT / PTT; Fibrinogen;**
- **CMBP**
- **INITIATE ADDITIONAL MTP2 PACKAGES with 20 Units of Cryoprecipitate**
- **Consider For Continued Life Threating Hemorrhage**
  Prothrombin Complex Concentrate (Kcentra)
  Factor 7 (NovoSeven)
  RiaSTAP ***for consumptive coagulopathy/DIC; severe hypofibrinogenemia or volume overload***

Calculating Corrected Calcium Equation
4- [(0.8 X Albumin] + serum Ca = corrected Ca

Developed 2/06 FBS_ rev10_09072010ds, 1/10/2011me, 2/14/11ej, 5/9/11me, 4/9/2014dg, 6/24/2014dg, 12/18/2017 dg, 01/04/2018 dg

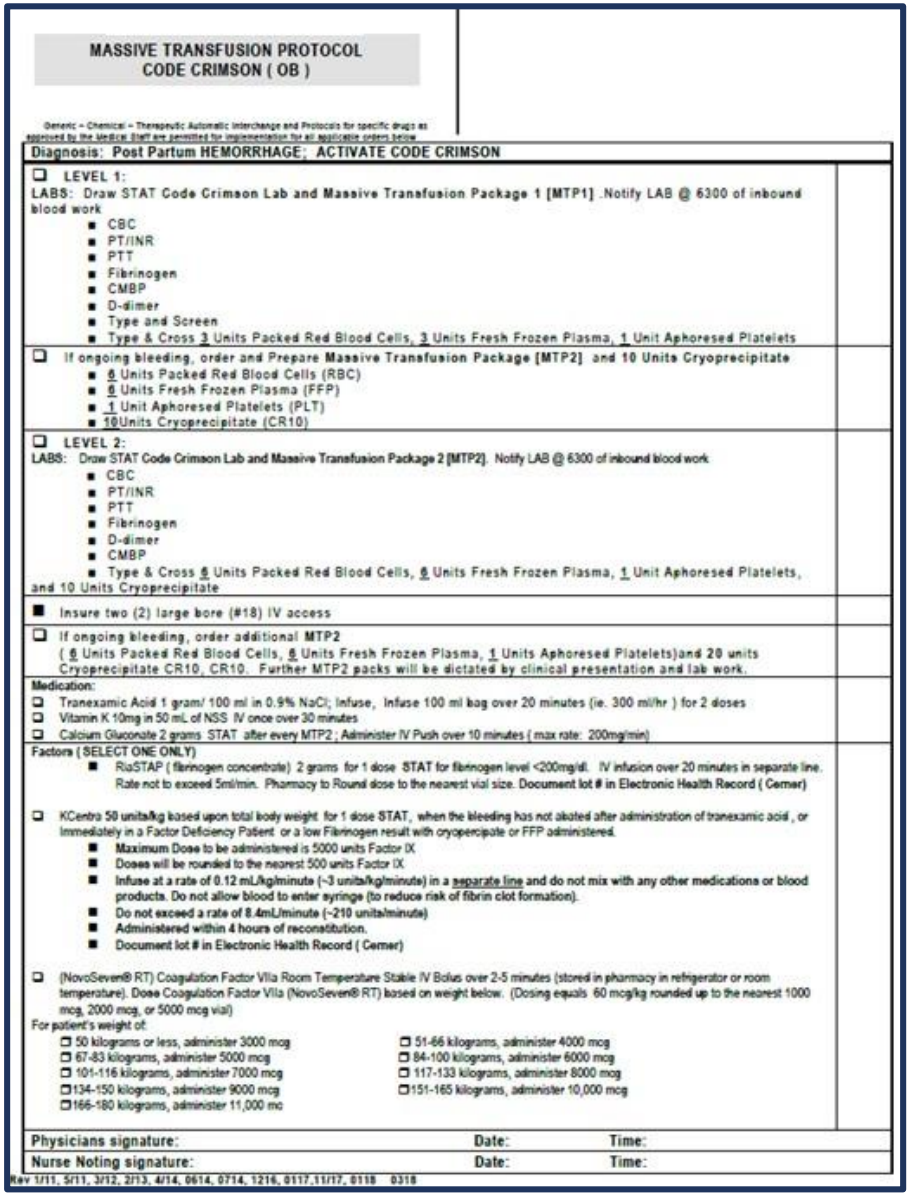
MASSIVE TRANSFUSION PROTOCOL [MTP]

Updated 01./2018



Massive Transfusion Protocol: Code Crimson

Electrolytes, including potassium and calcium can fluctuate wildly.



MASSIVE TRANSFUSION PROTOCOL
CODE CRIMSON (OB)

Generic – Chemical – Therapeutic Automatic interchange and Protocols for specific drugs as approved by the Medical Staff are permitted for implementation for all applicable orders below

Diagnosis: Post Partum HEMORRHAGE; ACTIVATE CODE CRIMSON

❑ **LEVEL 1:**
LABS: Draw STAT Code Crimson Lab and Massive Transfusion Package 1 [MTP1] .Notify LAB @ 6300 of inbound blood work
- CBC
- PT/INR
- PTT
- Fibrinogen
- CMBP
- D-dimer
- Type and Screen
- Type & Cross 3 Units Packed Red Blood Cells, 3 Units Fresh Frozen Plasma, 1 Unit Aphoresed Platelets

❑ **If ongoing bleeding, order and Prepare Massive Transfusion Package [MTP2] and 10 Units Cryoprecipitate**
- 6 Units Packed Red Blood Cells (RBC)
- 6 Units Fresh Frozen Plasma (FFP)
- 1 Unit Aphoresed Platelets (PLT)
- 10Units Cryoprecipitate (CR10)

❑ **LEVEL 2:**
LABS: Draw STAT Code Crimson Lab and Massive Transfusion Package 2 [MTP2]. Notify LAB @ 6300 of inbound blood work
- CBC
- PT/INR
- PTT
- Fibrinogen
- D-dimer
- CMBP
- Type & Cross 6 Units Packed Red Blood Cells, 6 Units Fresh Frozen Plasma, 1 Unit Aphoresed Platelets, and 10 Units Cryoprecipitate

■ **Insure two (2) large bore (#18) IV access**

❑ **If ongoing bleeding, order additional MTP2**
(6 Units Packed Red Blood Cells, 6 Units Fresh Frozen Plasma, 1 Units Aphoresed Platelets)and 20 units Cryoprecipitate CR10, CR10. Further MTP2 packs will be dictated by clinical presentation and lab work.

Medication:
❑ Tranexamic Acid 1 gram/ 100 ml in 0.9% NaCl; Infuse, Infuse 100 ml bag over 20 minutes (ie. 300 ml/hr) for 2 doses
❑ Vitamin K 10mg in 50 mL of NSS IV once over 30 minutes
❑ Calcium Gluconate 2 grams STAT after every MTP2 ; Administer IV Push over 10 minutes (max rate: 200mg/min)

Factors (SELECT ONE ONLY)
- RiaSTAP (fibrinogen concentrate) 2 grams for 1 dose STAT for fibrinogen level <200mg/dl. IV infusion over 20 minutes in separate line. Rate not to exceed 5ml/min. Pharmacy to Round dose to the nearest vial size. **Document lot # in Electronic Health Record (Cerner)**

❑ KCentra 50 units/kg based upon total body weight for 1 dose STAT, when the bleeding has not abated after administration of tranexamic acid , or immediately in a Factor Deficiency Patient or a low Fibrinogen result with cryoprecipate or FFP administered.
- **Maximum Dose to be administered is 5000 units Factor IX**
- **Doses will be rounded to the nearest 500 units Factor IX**
- **Infuse at a rate of 0.12 mL/kg/minute (~3 units/kg/minute) in a separate line and do not mix with any other medications or blood products. Do not allow blood to enter syringe (to reduce risk of fibrin clot formation).**
- **Do not exceed a rate of 8.4mL/minute (~210 units/minute)**
- **Administered within 4 hours of reconstitution.**
- **Document lot # in Electronic Health Record (Cerner)**

❑ (NovoSeven® RT) Coagulation Factor VIIa Room Temperature Stable IV Bolus over 2-5 minutes (stored in pharmacy in refrigerator or room temperature). **Dose Coagulation Factor VIIa (NovoSeven® RT) based on weight below. (Dosing equals 60 mcg/kg rounded up to the nearest 1000 mcg, 2000 mcg, or 5000 mcg vial)**

For patient's weight of:
- ❒ 50 kilograms or less, administer 3000 mcg
- ❒ 67-83 kilograms, administer 5000 mcg
- ❒ 101-116 kilograms, administer 7000 mcg
- ❒ 134-150 kilograms, administer 9000 mcg
- ❒ 166-180 kilograms, administer 11,000 mc
- ❒ 51-66 kilograms, administer 4000 mcg
- ❒ 84-100 kilograms, administer 6000 mcg
- ❒ 117-133 kilograms, administer 8000 mcg
- ❒ 151-165 kilograms, administer 10,000 mcg

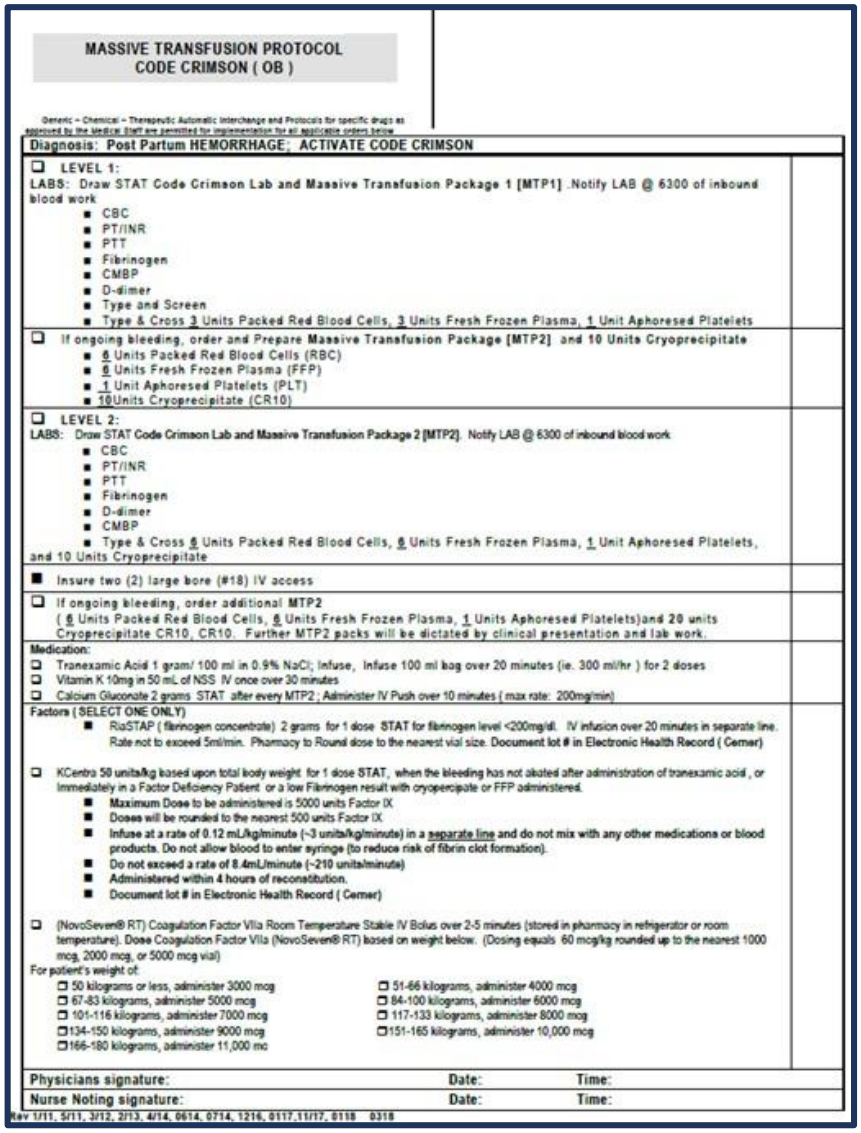
Physicians signature: **Date:** **Time:**
Nurse Noting signature: **Date:** **Time:**

Rev 1/11, 5/11, 3/12, 2/13, 4/14, 0614, 0714, 1216, 0117,11/17, 0118 0318

Source: Luis D. Pacheco M.D., George R. Saade, M.D., Maged M. Costantine, M.D., Steven L. Clark, M.D., & Gary D.V. Hankins, M.D. An update on the use of massive transfusion protocols in obstetrics. *American Journal of Obstetrics and Gynecology*, 2016-03-01, Volume 214, Issue 3.

Massive Transfusion Protocol: Code Crimson

- Kcentra
- Prothrombin complex concentrate should be used as a last resort in refractory cases of hemorrhage
- More favorable safety profile than Factor 7



MASSIVE TRANSFUSION PROTOCOL
CODE CRIMSON (OB)

Generic – Chemical – Therapeutic Automatic Interchange and Protocols for specific drugs as approved by the Medical Staff are permitted for implementation for all applicable orders below

Diagnosis: Post Partum HEMORRHAGE; ACTIVATE CODE CRIMSON

☐ **LEVEL 1:**
LABS: Draw STAT Code Crimson Lab and Massive Transfusion Package 1 [MTP1] .Notify LAB @ 6300 of inbound blood work
- CBC
- PT/INR
- PTT
- Fibrinogen
- CMBP
- D-dimer
- Type and Screen
- Type & Cross 3 Units Packed Red Blood Cells, 3 Units Fresh Frozen Plasma, 1 Unit Aphoresed Platelets

☐ **If ongoing bleeding, order and Prepare Massive Transfusion Package [MTP2] and 10 Units Cryoprecipitate**
- 6 Units Packed Red Blood Cells (RBC)
- 6 Units Fresh Frozen Plasma (FFP)
- 1 Unit Aphoresed Platelets (PLT)
- 10Units Cryoprecipitate (CR10)

☐ **LEVEL 2:**
LABS: Draw STAT Code Crimson Lab and Massive Transfusion Package 2 [MTP2]. Notify LAB @ 6300 of inbound blood work
- CBC
- PT/INR
- PTT
- Fibrinogen
- D-dimer
- CMBP
- Type & Cross 6 Units Packed Red Blood Cells, 6 Units Fresh Frozen Plasma, 1 Unit Aphoresed Platelets, and 10 Units Cryoprecipitate

■ **Insure two (2) large bore (#18) IV access**

☐ **If ongoing bleeding, order additional MTP2**
(6 Units Packed Red Blood Cells, 6 Units Fresh Frozen Plasma, 1 Units Aphoresed Platelets)and 20 units Cryoprecipitate CR10, CR10. Further MTP2 packs will be dictated by clinical presentation and lab work.

Medication:
☐ Tranexamic Acid 1 gram/ 100 ml in 0.9% NaCl; Infuse, Infuse 100 ml bag over 20 minutes (ie. 300 ml/hr) for 2 doses
☐ Vitamin K 10mg in 50 mL of NSS IV once over 30 minutes
☐ Calcium Gluconate 2 grams STAT after every MTP2 ; Administer IV Push over 10 minutes (max rate: 200mg/min)

Factors (SELECT ONE ONLY)
■ RiaSTAP (fibrinogen concentrate) 2 grams for 1 dose STAT for fibrinogen level <200mg/dl. IV infusion over 20 minutes in separate line. Rate not to exceed 5ml/min. Pharmacy to Round dose to the nearest vial size. **Document lot # in Electronic Health Record (Cerner)**

☐ KCentra 50 units/kg based upon total body weight for 1 dose STAT, when the bleeding has not abated after administration of tranexamic acid , or Immediately in a Factor Deficiency Patient or a low Fibrinogen result with cryoprecipate or FFP administered.
- **Maximum Dose to be administered is 5000 units Factor IX**
- **Doses will be rounded to the nearest 500 units Factor IX**
- **Infuse at a rate of 0.12 mL/kg/minute (~3 units/kg/minute) in a separate line and do not mix with any other medications or blood products. Do not allow blood to enter syringe (to reduce risk of fibrin clot formation).**
- **Do not exceed a rate of 8.4mL/minute (~210 units/minute)**
- **Administered within 4 hours of reconstitution.**
- **Document lot # in Electronic Health Record (Cerner)**

☐ (NovoSeven® RT) Coagulation Factor VIIa Room Temperature Stable IV Bolus over 2-5 minutes (stored in pharmacy in refrigerator or room temperature). Dose Coagulation Factor VIIa (NovoSeven® RT) based on weight below. (Dosing equals 60 mcg/kg rounded up to the nearest 1000 mcg, 2000 mcg, or 5000 mcg vial)

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- ☐ 50 kilograms or less, administer 3000 mcg
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- ☐ 67-83 kilograms, administer 5000 mcg
- ☐ 84-100 kilograms, administer 6000 mcg
- ☐ 101-116 kilograms, administer 7000 mcg
- ☐ 117-133 kilograms, administer 8000 mcg
- ☐ 134-150 kilograms, administer 9000 mcg
- ☐ 151-165 kilograms, administer 10,000 mcg
- ☐ 166-180 kilograms, administer 11,000 mc

Physicians signature:	**Date:**	**Time:**
Nurse Noting signature:	**Date:**	**Time:**

Rev 1/11, 5/11, 3/12, 2/13, 4/14, 0614, 0714, 1216, 0117,11/17, 0118 0318

Source: Luis D. Pacheco M.D., George R. Saade, M.D., Maged M. Costantine, M.D., Steven L. Clark, M.D., & Gary D.V. Hankins, M.D. An update on the use of massive transfusion protocols in obstetrics. *American Journal of Obstetrics and Gynecology*, 2016-03-01, Volume 214, Issue 3.

Critical Event Checklists

Postpartum Hemorrhage – Critical Event Checklist

Stage 1 Bleed

- ☐ Call for help and have someone bring the Uterine Tamponade Balloon Kit (Hemorrhage kit) to room
  - Notify Anesthesia, Charge Nurse, OB
- ☐ Establish IV access if not present (at least 18-gauge)
  - Establish 2nd large bore IV or Saline lock
  - Increase Oxytocin rate (to at least 500 mL/hr)
  - Draw STAT labs (CBC, PT/PTT, Fibrinogen/D Dimer, T & S) (notify lab of draw)
  - Type and Cross;
  - 3 units RBCs
  - 3 units FFP
  - 1 unit Aphoresed Platelets
- ☐ Continue vigorous fundal massage
- ☐ Get ready uterine tamponade balloon
- ☐ Administer Uterotonic medication ordered by Provider
  - No response to first dose – move on to alternate agent
  - Good response to first dose – give additional doses as ordered
- ☐ Tranexamic Acid (TXA)
- ☐ Empty bladder – consider indwelling catheter
- ☐ Weigh peri-pads and chux to estimate blood loss
  - Record blood loss volume every 15 minutes
- ☐ Physician or Midwife
  - Rule out retained Products of Conception, laceration, hematoma
- ☐ Surgeon if Cesarean Section
  - Inspect for uncontrolled bleeding at all levels, especially broad ligament, posterior uterus and retained placenta consider uterine tamponade
- ☐ Administer O_2 to keep sats greater than 95%
- ☐ Keep patient warm

Stage 2 Bleed

- ☐ All items from Stage 1 AND:
- ☐ Tranexamic Acid (TXA)
- ☐ Ensure labs are drawn and 'super STAT'
- ☐ Activate response team
  - Notify second OB
  - Anesthesia to bedside
  - Nursing Supervisor
  - Notify Blood Bank of Massive Transfusion Protocol and Designate a 'blood runner'
  - Get Rapid Infuser
  - Get ready uterine tamponade balloon
  - Interventional radiology if ability to do embolization
- ☐ Type and Cross total of: (MTP)
  - 6 units packed RBCs
  - 6 units FFPs
  - 1 unit Aphoresed Platelets
  - 10 units Cryoprecipitate
- ☐ Calcium Gluconate 2 grams (4.65mEq/1gm) IV
- ☐ Assess and announce vital signs every 5 minutes including pad/chux volume and O_2 sats
- ☐ Bimanual massage
- ☐ Record hourly urine output with urimeter
- ☐ Move to OR
  - Prepare Hysterectomy tray
  - Prepare for Embolization if available in house
- * *If bleeding ongoing – repeat CBC/PLTs, Coagulation panel II STAT and Chem 12 panel every 60 minutes or status post each massive transfusion protocol (MTP)
- ☐ Apply SCDs
- ☐ Use fluid warmer or rapid infuser

After 8-10 units of PRBCs and coagulation factor replacement may consider risk/benefit of rFactor VIIa

Medication doses

Oxytocin:
- Infusion 100 mL bolus (30 units/500 mL) over 20 minutes
- Premixed (30 units/500 mL) IVF – increased rate after delivery of placenta (at least 500 mL/hr)
- 10 units IM times 1 dose

Methylergonovine maleate (not with hypertension)
- 0.2 mg IM (NOT IV) every 2-4 hrs

Carboprost tromethamine (Hemabate) (not with Asthma)
- 250 mcg IM or intramyometrial (NOT IV) every 15-90 minutes - do not exceed 8 doses/24 hr

Misoprostol (Cytotec)
- 600 mcg - 1000 mcg PR time 1 dose
- 400 mcg - 800 mcg SL times 1 dose

Tranexamic Acid (TXA)
- 1 gram (10 mL of a 100 mg/mL Solution over 10-20 minutes) Repeat in 30 minutes if still bleeding

PRBCs (approximately 35-40 minutes for crossmatch once sample is in the lab and assuming no antibodies present)
FFP (approximately 35-45 minutes to thaw for release)
PLTs Local variation in time to release (may need to come from regional blood bank)
CRYO (approximately 35-45 minutes to thaw for release)

OB-1601 10/13 (Rev. 03/14, 05/14, 12/16, 08/18)

Massive Transfusion/Code Crimson Worksheet
Level 1

PPID Label

Notify Switchboard ext.5555

Time: _____

(Switchboard will alert Laboratory, Anesthesia, Ultrasound, IR, Nursing Supervisor and Pharmacy to await further instructions)

Second In-House OB Physician

Type and Cross Total of three units packed RBCs, three units FFP, one unit of platelets

Lab Results

(Repeat after each MTP or Q 1 hour until stable)

Draw STAT Labs _____

(CBC, PT/PTT, INR, Fibrinogen, Type and Cross, CMBP)

Result Time_____

Draw STAT Labs _____

(CBC, PT/PTT, INR, Fibrinogen, Type and Cross, CMBP)

Result Time_____

Notes:

Ensure IV Access

Site 1_____

Site 2_____

Foley Catheter Insertion_____

Administer O2 to keep sats greater than 95%

Keep Patient warm

Apply SCDs

Continuous vigorous fundal massage

Prepare

Uterine Tamponade Balloon Cart _____

OR Hysterectomy Pan_____

Prepare Rapid Infuser/Blood Warmer_____

Blood Products Intake *(Indicate in mLs)*

RBCs: Unit 1_____Unit 2_____Unit 3_____

FFP: Unit 1_____Unit 2_____Unit 3_____

Platelets:_____ **Cryoprecipitate:** _____

Total Blood Product Intake: _____

Vital Signs Q 5 Min including O2 sat _____ _____

_____ _____

Medications

Oxytocin 30 units/500mL at 500 mL/hr _____

Methergine 0.2 mg IM Q 2-4hrs_____

Hemabate 250mcg IM or intramyometrial (can be given every 15-90 minutes; do not exceed 8 doses in 24 hrs)

Dose 1_____ Dose 2_____

Dose 3_____ Dose 4_____

Misoprostol 600mcg- 1000mcg PR time 1 does_____

Or 600mcg- 800mcg SL or po X1 _____

Tranexamic Acid 1 gm/100ml NSS IV over 20 min

Repeat in 30 min if bleeding not controlled.

Dose 1_____ Dose 2_____

Additional IV Intake

IV Fluids: _____

_____

Output/ EBL *(Record blood loss volume Q 15min)*

(Weigh EBL 1gm= 1cc)

Delivery EBL: _____ Delivery Urine Output:_____

Additional blood loss: _____

Additional Hourly Output: _____

Signature:

_____

HEALTHTRUST

Massive Transfusion/Code Crimson Worksheet
Level 2

PPID Label

Type and Cross Total of six units packed RBCs, six units FFP, one unit of platelets, ten units' cryoprecipitate, and additional MTP2 packages with 20 units of cryoprecipitate

Lab Results

(Repeat after each MTP or Q1 hour until stable)

Draw STAT Labs _____
(CBC, PT/PTT, INR, Fibrinogen, Type and Cross, CMBP)
Result Time_____

Draw STAT Labs _____
(CBC, PT/PTT, INR, Fibrinogen, Type and Cross, CMBP)
Result Time_____

Notes:

Output/ EBL *(Record blood loss volume Q 15min)*
(Weigh EBL 1gm= 1cc)

Delivery EBL: _____ Delivery Urine Output:_____

Additional blood loss: _____

_____

Additional Hourly Output: _____

Blood Products Intake *(Indicate in mLs)*

RBCs: Unit 1_____ Unit 2_____ Unit 3_____ Unit 4_____ Unit 5_____ Unit 6_____

FFP: Unit 1_____ Unit 2_____ Unit 3_____ Unit 4_____ Unit 5_____ Unit 6_____

Platelets: _____ **Cryoprecipitate:** _____

Total Blood Product Intake: _____ **Calcium Gluconate:**_____

Blood Products Intake *(Indicate in mLs)*

RBCs: Unit 1_____ Unit 2_____ Unit 3_____ Unit 4_____ Unit 5_____ Unit 6_____

FFP: Unit 1_____ Unit 2_____ Unit 3_____ Unit 4_____ Unit 5_____ Unit 6_____

Platelets: _____ **Cryoprecipitate:** _____

Total Blood Product Intake: _____ **Calcium Gluconate:**_____

Medications *(Refer to page 1)*

Vitamin K 10 mg IV 1 dose_____
Prothrombin Complex Concentrates_____
Factor 7 _____
RiaSTAP _____

Additional IV Intake

IV Fluids: _____

_____

Notes:

Signature:
_____

Battling Coagulopathy

"Sometimes things go very bad"

Fibrinogen is Key

Substrate of all clot

↓

No / Low Fibrinogen

↓

No Clot

↓

Exsanguination

(Can occur in 10 to 12 minutes in extreme cases)

Battling Coagulopathy, *continued*

- Fibrinogen < 200 mg/dl
- 100% positive, predictive value for life-threatening obstetrical hemorrhage

Critically Low Fibrinogen Renders All Other Measures Poorly Effective

Adverse Case Review Results Show:

- Prothrombin complex concentrates (Kcentra or FEIBA) *Poorly effective*
- Factor 7 *Poorly effective*
- TXA *sub-optimally effective* (will help stabilize any residual clot)
- Life-saving hysterectomy (not always so)

Increase Fibrinogen While Concomitantly Engaging in Other Lifesaving Measures

- Repeat TXA Hysterectomy Pelvic Packing
- Interventional Radiology
- Hypogastric artery ligation if surgeon is proficient
- Aortocaval hand compression while catching up
- Prothrombin Complex Concentrate*
- Factor VII

Source: *Luis D. Pacheco, M.D., George R. Saade, M.D., Maged M. Costantine, M.D., Steven L. Clark, M.D., and Gary D.V. Hankins M.D. An update on the use of massive transfusion protocols in obstetrics. American Journal of Obstetrics and Gynecology, 2016-03-01, Volume 214, Issue 3.

Treatment of Consumptive Coagulation / DIC

Part of the Death Triad

- Acidemia
  - Prevented by increasing O2 Delivery via PRBCs (Prevent or Repay Oxygen Debt) Sodium Bicarbonate Therapy
- Hypothermia
  - Prevented with Bair Hugger / High Capacity Blood / IV Fluid Warmer
- Consumptive Coagulation /DIC
  - Correction is sometimes extremely complex

Three Broad Examples—Case Example 1

Patient Profile

- Hemoglobin 7
- PT /PTT is Normal
- Fibrinogen is 250

(Normal Pregnancy Value for Fibrinogen is 301 to 696, less than 300=Red Flag)

Coagulation Goal

- Use Standard MTP
- 6 PRBCs, 6 FFP, 1 Platelet and 10-20 units cryoprecipitate

Hematological GOAL:
Hbg ≥ 10 gm/dl – antepartum
Hbg ≥ 8 gm/dl - postpartum
Plt ≥ 50,000 mm^3
Fibrinogen > 200mg/dl
PT < 1.5 x control
PTT < 1.5 x control

Expected Fibrinogen Increase
6 units FFP to increase Fibrinogen 60mg/dl
10 units cryoprecipitate to increase 50 mg/dl
in 100 kg/pt (220 lb)

RiaSTAP 2 GM dose of will increase Fibrinogen approximately 80 mg/dl

Three Broad Examples, *continued*—Case Example 2

Patient Profile 2

- Hemoglobin is 9
- PT / PTT is twice the normal value
- Fibrinogen 175

(Normal Pregnancy Value for Fibrinogen is 301 to 696, less than 300 Red Flag)

Coagulation Goals

- FFP 4 Units
  - Clotting factors should normalize PT /PTT
- Administration of clotting factors should increase the Fibrinogen by approximately 40 mg/dl
- Total Fibrinogen at goal/ Approximately 215 mg/dl

Hematological GOAL:
Hbg ≥ 10 gm/dl – antepartum
Hbg ≥ 8 gm/dl - postpartum
Plt ≥ 50,000 mm^3
Fibrinogen > 200mg/dl
PT < 1.5 x control
PTT < 1.5 x control

Expected Fibrinogen Increase
6 units FFP to increase
Fibrinogen 60mg/dl
10 units cryoprecipitate to
increase 50 mg/dl
in 100 kg/pt (220 lb)

RiaSTAP 2 GM dose of will
increase Fibrinogen
approximately
80 mg/dl

Three Broad Examples, *continued*—Case Example 3

Patient Profile

- Hemoglobin is 8
- PT/PTT is 1.5 times normal
- Fibrinogen 100

(Normal Pregnancy Value for Fibrinogen is 301 to 696, less than 300 Red Flag)

Coagulation Goals

- PRBC 2 Units
- 4 Units FFP should increase fibrinogen by 40 mg/dl
- 20 units cryoprecipitate should increase fibrinogen by 100 mg /dl
- Total Fibrinogen should achieve goal of approximately 240 mg/dl

Hematological GOAL:
Hbg ≥ 10 gm/dl – antepartum
Hbg ≥ 8 gm/dl - postpartum
Plt ≥ 50,000 mm^3
Fibrinogen > 200mg/dl
PT < 1.5 x control
PTT < 1.5 x control

Expected Fibrinogen Increase
6 units FFP to increase
Fibrinogen 60mg/dl
10 units cryoprecipitate to
increase 50 mg/dl
in 100 kg/pt (220 lb)

RiaSTAP 2 GM dose of will
increase Fibrinogen
approximately
80 mg/dl

Fibrinogen is Key

- Normal Pregnancy Value 301 to 696 mg/dl
  - Red Flag < 300
  - 100% PPV PPH < 200 *
  - No Clot Formation < 100
- Critically low fibrinogen levels (≤ 100-150) cannot be returned to normal using only FFP w/o cryoprecipitate
  - In some cases, established coagulopathy needs fibrinogen concentrate (Ria-STAP) for correction
- Use all blood component therapy as needed

Source: Charbit et al. J Thromb Haemost (2007)

Riastap: Fibrinogen Concentrate

- Heat treated lyophilized powder from pooled source
- Available at some institutions
- 1 vial=600-1300mg fibrinogen
- Obstetrical dosing: 2grams → in fibrinogen of approximately 80 mg/dl
- Pharmacologic armament for severe hemorrhage

Source: *Ahmed S. Transfusion Medicine* 2012

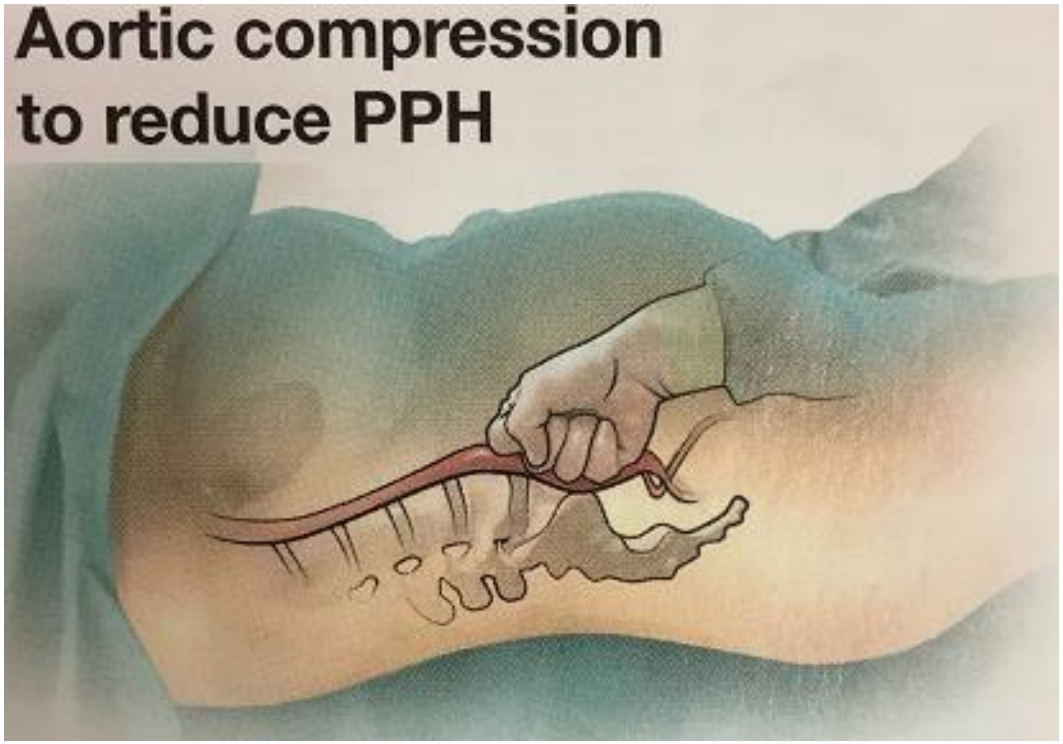
Mentor's Pearl

- **PUT IT ON!!!**
- You can always take it off later (Lasix)
- Risk of exsanguination and death from resultant coagulopathy and academia is greater than fluid overload and pulmonary edema

De-escalate Blood Component Therapy When Stable

Surgical Caveat

Utilize aortic compression while “catching up” with blood component therapy



Surgical Caveat, *continued*

- Re-explore if necessary to remove blood clot, blood breakdown products and re-inspect pedicles
- Retained clot may activate fibrinolytic system and potentiate consumptive coagulopathy

All Obstetrical Centers

- Know your limits
  - *But prepare for the worst*
- Planning is everything
- Liberal transfer policy
  - *Preferably before labor*

Pregnancy/Admission Risk Factors

Low (Clot Only)	Medium (Type and Screen)	High (Type and Crossmatch)
No previous uterine incision	Prior Cesarean birth(s) or uterine surgery	Placenta previa, low lying placenta
Singleton pregnancy	Multiple gestation	Suspected placenta accrete, percreta, increta
≤ 4 previous vaginal births	> 4 previous vaginal births	Hematocrit<30 AND other risk factors
No known bleeding disorder	Chorioamnionitis	Platelets <100,000
No history of post partum hemorrhage	History of previous post partum hemorrhage	Active bleeding (greater than show) on admit
	Large uterine fibroids	Known coagulopathy

Additional **risk factors that may develop in labor** include:

- Prolonged second stage
- Prolonged oxytocin use
- Active bleeding
- Chorioamnionitis
- Magnesium Sulfate treatment

Additional third stage/postpartum risk factors for hemorrhage stemming from the birth process include:[1,5]

- Vacuum- or forceps-assisted birth
- Cesarean birth (especially urgent/emergent cesarean)
- Retained placenta

Source: CMQCC OBSTETRIC HEMORRHAGE TOOLKIT Version 2.0 3/24/15

All Obstetrical Centers

Postpartum Hemorrhage Risk Assessment Should be Completed by All Birthing Centers

- History of PPH
- Large Fibroid
- Grand Multiparty
- Uterine Overdistension
- Macrosomia
- Polyhydramnios
- Multiple gestations
- Placenta Previa
- Inherited bleeding diathesis
- Chorioamnionitis
- Retained placenta tissue/Membranes
- Use of uterine relaxing agents (Tocolytics halogenated anesthetics nitroglycerin)
- Prolonged labor/Oxytocin use

All Obstetrical Centers, *continued*

- Screen all patients for Morbidly Adherent Placenta
- Where is the placenta?!
- Confirm location relative to scar

Transfer any patient at risk to a Center of Excellence for Placenta Accreta

Wise obstetrician left placenta in, closed uterus and transferred!

Code Crimson / Massive Transfusion Protocol (MTP)

- Facilities with limited Blood Banking resources have the capacity to administer PRBCs, FFP and cryoprecipitate with limited platelet availability
- May run out of PRBCs
- Consider fresh frozen plasma (FFP) as primary resuscitative fluid
- FFP and cryoprecipitate have long shelf life/low cost
- U.S. military looking at usage of FFP as primary resuscitative volume expander
- FDA cleared freeze-dried plasma for military use
- Judicious resuscitation with crystalloids/colloids
- Permissive hypotension so as not to disrupt clot or exacerbate blood loss
- Target systolic blood pressure @ 90
- Non-Pneumatic Anti-Shock Garment (NASG) – endorsed by the World Health Organization
  - Consideration for all OB units

Source: UpToDate MTP 2014, Shock volume 40 no.6 2013

Code Crimson / Massive Transfusion Protocol (MTP), *continued*

Use of Hemostatic Tools

- Fibrin sealants (Tisseel)
- Topical Thrombin (Thrombogen, Costasis)
- Hemostatic matrices (Floseal, Surgiflo)
- Gelatin Sponges (Gelfoam)
- Oxidized regenerated cellulose (Surgicel)
- Microfibrillar Collagen (Avitene)
- Cellulose Hemostatic matrix products (fibrillar, Surgicel SNoW)
- Use singly or together to control bleeding surfaces
- Helpful with diffuse low volume bleeding of coagulopathy

Code Crimson / Massive Transfusion Protocol (MTP), *continued*

Use of Hemostatic Tools

- Uterine Tamponade Balloon / Packing
- Uterine Compression Sutures
- Pelvic Pressure Pack
- Interventional Radiology
- Penrose or Foley Around Uterus
- Expeditious Transfer Plan vs. Timely Definitive Procedure LIFE-SAVING HYTERECTOMY

Miscellaneous Pearls

- Keep patient warm—Utilize high capacity rapid infuser / fluid warmer for PRBC, FFP, Platelets, Cryoprecipitate and IV fluids
- Hypothermia is part of “Death Triad”
- Utilize high capacity blood product warmer/ 8 bays (*Total Cost:$6,560.31*)
- Last in, First out blood bank policy for PRBCs
- PRBCs are actively metabolizing
- Decrease risk of storage lesion which can lead to hemolysis and hyperkalemia

Massive Transfusion Protocol Equipment

High Capacity Blood Component Therapy Warmer

- Eight Warming bays accommodate 1 MTP
- Six units of FFP
- Two 5 packs of cryoprecipitate

Massive Transfusion Protocol Equipment

High Volume Rapid IV Blood Component Therapy Infuser

- Important to have an 18-gauge IV or central line
- Infuses within one minute

Massive Transfusion Protocol Equipment

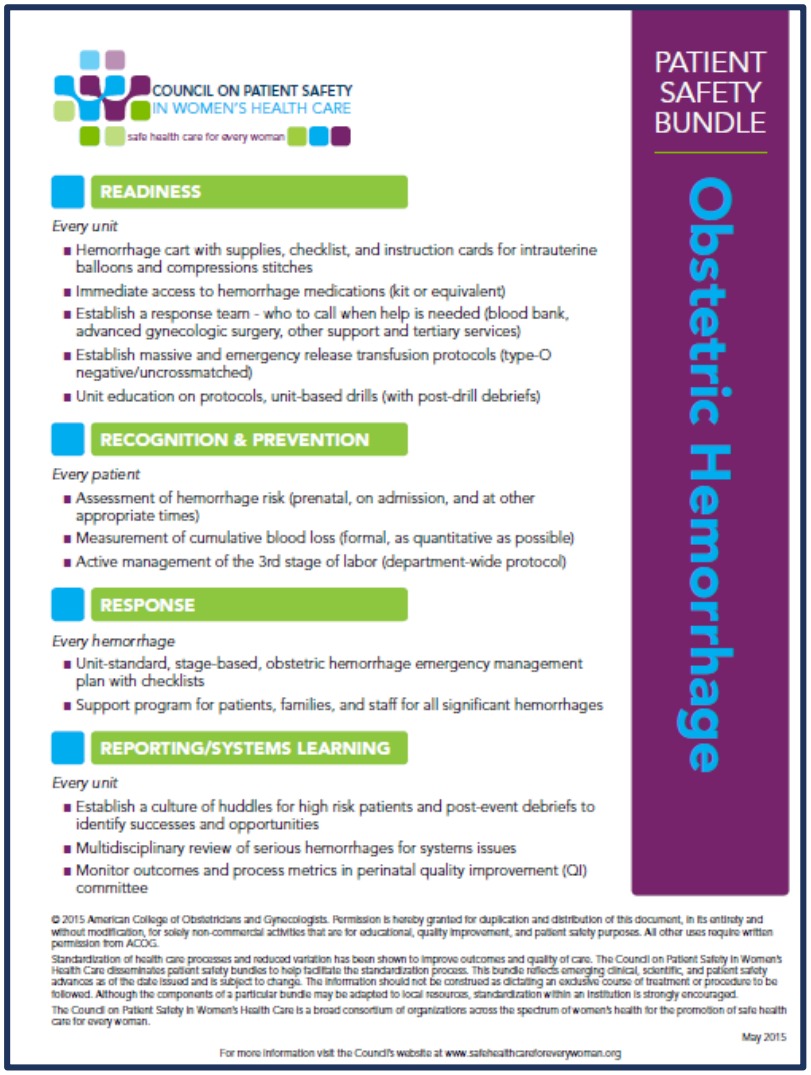
Utilize Advanced Tissue Sealant Technology for Lifesaving Hysterectomy

Complications of Massive Transfusion

Adverse events	Comments and potential treatments
Transfusion reactions	
Allergic	Range from simple urticarial to anaphylaxis. Steroid and diphenhydramine might be given to patients with allergic transfusion
Haemolytic transfusion reaction (acute and delayed)	Might be reduced by giving group O RBCs and AB plasma for emergency release of blood products
Febrile non-haemolytic transfusion reaction	Diagnosis of exclusion
Immunological reactions	
Transfusion-related acute lung injury (TRALI)	Incidence can be reduced by transfusing male-only plasma
Transfusion-related immunomodulation (TRIM)	Might be responsible for increased risk of bacterial infection
Transfusion-associated graft *vs* host disease (Ta-GVHD)	Irradiation of cellular blood products in patients at risk (such as neonates and immunosuppressed patients) to prevent Ta-GVHD
Post-transfusion purpura (PTP)	Can be treated with IVIg infusion, steroid, or plasma exchange
Metabolic complications	
Hypocalcaemia*	Because of citrate overload from rapid transfusion of blood products. Neonates and patients with pre-existing liver disease are at risk for hypocalcemia. Monitor ionized calcium level and correct if necessary
Hypomagnesaemia*	Because of large volume of magnesium-poor fluid and citrate overload. Monitor ionized magnesium level and correct if necessary
Hyperkalaemia*	Because of haemolysis of RBC from storage, irradiation, or both. Neonates and patients with pre-exisiting cardiac and renal diseases are at risk for hyperkalaemia. Monitor potassium level and correct if necessary. Fresh RBCs (<5–10 days old), irradiated <24 h before transfusion or washing may decrease risk
Hypokalaemia*	Because of re-entry into transfused RBCs, release of stress hormones, or metabolic alkalosis. Monitor potassium level and correct if necessary
Metabolic alkalosis*	Because of citrate overload. Monitor acid–base status
Acidosis*	Because of hypoperfusion, liver dysfunction, and citrate overload. Monitor acid–base status
Hypothermia*	Because of infusion of cold fluid and blood products, opening of body cavities, decrease heat production, and impaired thermal control. Neonates and infants are at increased risk. Blood warmer should be used
Other adverse events	
Haemostatic defects*	Result from complex mechanism (discuss in the pathophysiology section)
Infection	Can result from blood products or other resuscitated procedures, such as surgeries
Transfusion-associated circulatory overload (TACO)*	Should be differentiated from TRALI. Infants and patients with pre-existing cardiac disease are at increased risk. Oxygen and diuresis can be used
Air embolism	A rare fatal complication. Instructions and/or protocols on how to use rapid infuser must be followed

Source: H.P. Pham & B.H. Shaz BJA (2013)

Alliance for Innovation on Maternal Health Program



COUNCIL ON PATIENT SAFETY IN WOMEN'S HEALTH CARE

safe health care for every woman

PATIENT SAFETY BUNDLE

Obstetric Hemorrhage

READINESS

Every unit

- Hemorrhage cart with supplies, checklist, and instruction cards for intrauterine balloons and compressions stitches
- Immediate access to hemorrhage medications (kit or equivalent)
- Establish a response team - who to call when help is needed (blood bank, advanced gynecologic surgery, other support and tertiary services)
- Establish massive and emergency release transfusion protocols (type-O negative/uncrossmatched)
- Unit education on protocols, unit-based drills (with post-drill debriefs)

RECOGNITION & PREVENTION

Every patient

- Assessment of hemorrhage risk (prenatal, on admission, and at other appropriate times)
- Measurement of cumulative blood loss (formal, as quantitative as possible)
- Active management of the 3rd stage of labor (department-wide protocol)

RESPONSE

Every hemorrhage

- Unit-standard, stage-based, obstetric hemorrhage emergency management plan with checklists
- Support program for patients, families, and staff for all significant hemorrhages

REPORTING/SYSTEMS LEARNING

Every unit

- Establish a culture of huddles for high risk patients and post-event debriefs to identify successes and opportunities
- Multidisciplinary review of serious hemorrhages for systems issues
- Monitor outcomes and process metrics in perinatal quality improvement (QI) committee

Standardization of health care processes and reduced variation has been shown to improve outcomes and quality of care. The Council on Patient Safety in Women's Health Care disseminates patient safety bundles to help facilitate the standardization process. This bundle reflects emerging clinical, scientific, and patient safety advances as of the date issued and is subject to change. The information should not be construed as dictating an exclusive course of treatment or procedure to be followed. Although the components of a particular bundle may be adapted to local resources, standardization within an institution is strongly encouraged.

The Council on Patient Safety in Women's Health Care is a broad consortium of organizations across the spectrum of women's health for the promotion of safe health care for every woman.

May 2015

For more information visit the Council's website at www.safehealthcareforeverywoman.org

Case Report 2016

41 years old Gravida 5 Para 4

- Status post C-Section for fetal Intolerance of labor
- Diagnosed with intraoperative expanding retroperitoneal hematoma
- Transferred to Interventional Radiology for uterine artery embolism
- Bleeding stopped / patient stable

18 hours post-op

Patient has mental status change, acute abdominal distension, hypotension and maternal cardiac arrest.

Case Report 2016, *continued*

Emergently returned to OR for exploratory laparotomy

- 5 liters of blood in abdomen. Femoral artery ruptured and retracted into the abdomen.
- Black Hawk Down Junctional Injury

MTP/Code Crimson Called

- OB team evacuated clot and held pressure
- 2 vascular surgeons called to repair femoral artery and place vascular graft

Expert Highly Reliable Collaborative Care

- Post Partum Patient in Extremis
- 10 Liter Blood Loss
- 6 Hours of Cumulative Surgery
- 78 Units of Blood Component Therapy
- 65 Hospital Staff & Employees
- 11 Specialties and Sub-specialties
- 40 Day Hospital Stay
- 21 Day Rehabilitation

Mother of 5 home to children & husband!

HEALTHTRUST

Take-home Message

- Patients in extremis do not allow “do overs”
- Study Code Crimson / MTP
- Implement Code Crimson / MTP
- Drill Code Crimson / MTP
- Practice doesn’t make perfect, **perfect practice makes perfect**

It is incumbent on all healthcare professionals to take the responsibility to begin adopting new approaches, new tools and new thinking to reverse the rates of maternal mortality and morbidity in the U.S.

Thank you

Frank R. Kolucki, Jr. M.D., FACOG
FKolucki@mth.org

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